Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of:	)	
Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation	)	ET Docket No. 93-62

SUPPLEMENTARY COMMENTS OF MARJORIE LUNDQUIST, Ph.D., C.I.H., IN RELATION TO HER PROPOSAL FOR A STANDARD FOR PROTECTION AGAINST NONTHERMAL HEALTH HAZARDS (SUCH AS CANCER), WITH SPECIAL ATTENTION TO TRANSMITTERS EMITTING PULSED SIGNALS

July 17, 1997

I am submitting further comments triggered by the publication in May, 1997, of a report on mice exposed in the laboratory to a pulsed 900 MHz signal from a linear antenna. The purpose of the experiment was to simulate exposure in the far field of a wireless mobile radio antenna.

The document to which I am referring is

Lymphomas in Eμ-*Pim1* Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields **Radiation Research 147** (May 1997) 631-640.

Michael H. Repacholi, Antony Basten, Val Gebski, Denise Noonan, John Finnie & Alan W. Harris

and I am enclosing the abstract from it herewith (intending to include the entire report by reference).

There was a doubling of the cancer incidence in the mice exposed to the radiation from what was, essentially, the electromagnetic field around a dipole antenna.

These mice were *specific-pathogen-free*, just like the rats that were exposed to circularly-polarized pulsed microwave radiation at 2.45 GHz inside a waveguide in a lifetime exposure

study sponsored by the U.S. Air Force. The document reporting these results is

Long-Term, Low-Level Microwave Irradiation of Rats

C.-K. Chou, A. W. Guy, L. L. Kunz, R. B. Johnson, J. J. Crowley and J. H. Krupp.

Bioelectromagnetics 13 (1992) 469-496

and I am enclosing the abstract from it, together with Table 2, which shows that there were five primary malignancies in the 100 sham-exposed rats, while there were 18 primary malignancies in the 100 exposed rats: a more-than-three-fold increase in cancer incidence attributable to microwave exposure! [See totals at end of Table 2 in columns headed "P".]

The fact that both sets of animals were *specific-pathogen-free* means that pathogens could *not* have been responsible for the cancers that appeared in the animals in either of these two experiments.

There has been considerable discussion—by e-mail—between me, Dr. Repacholi, and his advisors on one point: Were the mice in this experiment *really* in the far field of the antenna at 900 MHz? I enclose selected portions of this correspondence.

With respect to 900 MHz, I think all of us now agree that the mice in this experiment were indeed in the far field. This makes the findings unexpected, because an increase in cancer risk of this magnitude ought not to have occurred as a result of being in the *far field* of a 900 MHz source. It would not have been unexpected, had the mice been in the *near field* of a 900 MHz source (or in the near field of a higher-frequency source). Such results might even have been obtained, had the mice been in the far field of a much higher-frequency source. Or they might have been obtained, had the mice been simultaneously irradiated by a variety of sources of different frequencies in the neighborhood of, and above, 900 MHz, the mice being in the far field of all such sources.

Actually, there is good reason to consider that this last actually *did* occur in this experiment! The irradiated mice may also have been in the *near field* of other frequencies not measured; it is even more likely that they were close to, but not "well within", the far field for certain other frequencies not measured.

In my e-mail correspondence I urged that a Fourier analysis of the signal be carried out and published. The reason for this is that the pulsing of a signal introduces *other* frequencies, both higher and lower than the nominal frequency. Since the formula for the boundary of the far field is a function of frequency, it is possible for the mice in this experiment to be in the far field with respect to 900 MHz, but in the near field with respect to some of the higher frequencies that might have been introduced by the pulsing of the signal—*all at the same time!*

Because the observed increase in cancer incidence in the mice would *not* have been unexpected, had they been in the *near field* of the antenna, it is not unreasonable to suppose that the cancer hazard to these mice came from some or all of the frequencies introduced by the pulsation of the signal *for which these mice were in, or close to, the near field* of the antenna!

On this assumption, it is possible to calculate the offending frequencies, given the distance of the mice from the antenna. A Fourier analysis of the signal is then necessary to obtain the intensity profile at the frequencies of interest. This hypothesis could be tested by subjecting such mice in the laboratory to a continuous (non-pulsed) signal of the same profile at these higher frequencies only, the mice being at the same distance from the new antenna as from the one in the Repacholi experiment. If the results were the same, this would confirm that it is indeed the high-frequency portion of the signal from this antenna, which was introduced by

pulsing the signal—*not* the nominal 900 MHz frequency—that is responsible for the observed increase in cancer incidence. So far as I am aware, no such experiment is contemplated at this time by anyone doing research is this area.

Notice that the dependence of the far-field boundary on wavelength λ (lambda) is different for the elemental dipole (an exceedingly short dipole) and an antenna of finite length. For the elemental dipole, this boundary depends directly on λ, meaning that this boundary is farther away from the radiation source at large λ (low frequencies). The elemental dipole antenna was the basis for the equation given in my booklet **Cellular Telephones and Cellular Towers: GUIDELINES FOR CANCER PREVENTION** (which I submitted to this Docket at an earlier date). There I employed a large safety factor, to allow for factors not explicitly considered. [This booklet now needs to be rewritten, replacing the equation based on the elemental dipole with one based on an antenna of finite length.]

For a finite antenna, this boundary depends *inversely* on λ, which means that this boundary is farther away at small λ (high frequencies). This produces results that are in accord with actual experience.

All real antennas have a finite length, so the boundary of the far field gets farther away from the antenna as the frequency goes up. Thus the hazardous near field occupies an ever-larger region of space around the antenna as the frequency climbs. [This is one reason why the hazard of non-ionizing radiation rises as the frequency increases.]

Consider an antenna that is emitting a broad spectrum of frequencies (which every antenna emitting a pulsed signal is doing, in effect) and consider also that there is a target at a fixed distance r_t from this antenna. Let λ_{bff} be the wavelength for which the target is just at the boundary of the far field, and let f_{bff} be the corresponding frequency. [Here the boundary of

the far field means the distance from the field source at which the field has 50% far field character, 50% near field character.] Of course, $\lambda_{bff} f_{bff} = c$, the speed of light in a vacuum, or in air.

If the antenna is linear, then the following equation is reasonable for the distance of the far field boundary from the antenna in terms of wavelength (in air) or frequency [**Microwave Antenna Theory and Design**, Samuel Silver, ed.; McGraw-Hill Book Co., 1949; page 198]:

$$r_{bff} = D^2/2\lambda = D^2 f/2c. \quad (1)$$

Conversely, the wavelength for which a given distance r_t lies at the boundary of the far field can be calculated from the same equation

$$\lambda_{bff} = D^2/2r_t \quad (2)$$

which can also be written in terms of frequency as

$$f_{bff} = 2c\, r_t/D^2. \quad (3)$$

*Note that the equations above are for the **50% boundary** of the far field!*

In the Repacholi experiment, it was desired that the mice be *well within* the far field—at a *greater* distance from the antenna than the boundary of the far field. Thus the minimum distance r_{wff} for which a target could be considered to be *well within* the far field (only 10% influence from the near field, roughly) was considered to be:

$$r_{wff} = 4\, r_{bff}$$

thus

$$r_{wff} = 2D^2/\lambda = 2f D^2/c \quad (4)$$

which will be recognized as the equation used in the Repacholi paper. From this are obtained the equations

$$\lambda_{wff} = 2D^2/r_t \quad (5)$$

and

$$f_{wff} = cr_t/(2D^2). \quad (6)$$

Using Equations (2) and (5) for the wavelength, and Equations (3) and (6) for the frequency, Table I below is developed to show which of the frequencies introduced by the pulsing of the 900 MHz signal in the Repacholi experiment produce a near field, a "transition field" or a far field at a distance of 65 cm from the antenna, which is where the experimental mice were located. The length D is the effective antenna length (monopole antenna plus its image in the ground plane = dipole antenna of length D) and this was half the wavelength for 900 MHz, or half of 33.3 cm.

For frequencies above f_{bff} (wavelengths below λ_{bff}), the mice in the Repacholi experiment would have been in the near field of the antenna: in a region where the near-field character was above 50%. For frequencies below f_{bff} but above f_{wff}, the mice were in a "transition region" where the near-field character of the field declined from 50% to 10%. For frequencies below f_{wff} the mice were "well within" the far field of the antenna.

TABLE I.

(Repacholi experiment)

Fixed distance from antenna: r_t = 65 cm.

Length of antenna: D = ½ λ(900 MHz) = (½) 33.3 cm.

Field Character	Frequency	Wavelength
near field		
	f_{bff} = 142.1 GHz	λ_{bff} = 0.211 cm.
transition into far field		
	f_{wff} = 35.47 GHz	λ_{wff} = 0.845 cm.
well within far field		
	Nominal: 0.9 GHz	33.3 cm.

This table is important because the pulsed character of the applied signal produced other frequencies besides the applied frequency of 900 MHz. This table indicates that the introduced frequencies of possible concern in this experiment were frequencies above 142 GHz (because the mice at 65 cm. from the antenna were in the near field for these frequencies) and also frequencies between 35 and 142 GHz (because the mice at 65 cm. from the antenna were in the transition region of the far field for these frequencies).

Of course, a Fourier analysis of the applied signal is needed to find out what frequencies were actually present, and at what intensity. None is available for the Repacholi experiment, so no statement can be made about which frequencies introduced by pulsation of the signal contributed importantly to the cancer risk of these mice. In other words, the absence of a Fourier analysis of the signal to which the mice in the Repacholi experiment were subjected makes it impossible for anyone to make even a tentative identification of the frequencies that actually produced the increased cancer incidence observed in this experiment! All that can be done is to identify the range within which the responsible frequencies lie, which I have done in Table I above.

It should be noted that the fixed distance of 65 cm employed to develop Table I above is probably not realistic as a distance from the antenna for someone using a cellular telephone. A similar table for a different fixed distance must be developed to evaluate *that* situation!

A similar set of calculations can be made for pulsed signals at the nominal frequency used in PCS systems—1.9 GHz—and a similar table prepared, if the length of the antenna is known. To do this, I visited a PrimeCo store and measured the extended antenna on several of the cellular phones that were for sale; it was 9 cm. I asked the saleswoman to go through the motions of making a call, and measured the distance to her head from the tip and the

base of the antenna. The former distance was 7.5 cm, while the latter was 3.7 cm. The center of this linear antenna was therefore about 5.6 cm from the outside of her head. I have added 1.4 cm to this to reach to the surface of the brain, and so have set D = 7 cm.

TABLE II.

(Cellular telephone)

Distance from antenna: r_t = 7 cm.; Length of antenna: D = 9 cm.

(These parameters are assumed to be valid for GMS radiotelephones.)

Field Character		Frequency	Wavelength
near field			
		f_{bff} = 5.17 GHz	λ_{bff} = 5.80 cm.
transition into far field			
	PCS Nominal:	1.9 GHz	15.8 cm.
		f_{wff} = 1.3 GHz	λ_{wff} = 23.2 cm.
well within far field			
	GMS Nominal:	0.9 GHz	33.3 cm.

Table II is important because we can see from it that a PCS cellular phone is *not* well within the far field! Because of its higher nominal frequency, compared to the GMS phone, its nominal frequency is within the transition region. It employs a digital signal, which means there is a degree of pulsation to its signal. A Fourier decomposition of its signal is needed to obtain quantitative information, but even without a Fourier analysis of a PCS phone signal, it is easy to see from Table II that there certainly are frequencies present in the range between 1.9 and 5.17 GHz, and there very probably are frequencies above 5.17 GHz present, also—that is, the brain of a PCS cellular phone user's head is exposed to an electromagnetic field that includes frequencies with appreciable near-field components, and may also include frequencies for which the exposure is to the full near field.

On the basis of the limited information available, I can say with great confidence that the signals from PCS system devices pose *by far the greatest nonthermal hazard to health* of any of the three cellular phone systems in current use: the original system that began operation over a decade ago (which emits an analog signal between 800 and 900 MHz); the PCS system (which emits a digital signal at about 1.9 GHz); and the GMS (which emits a pulsed signal at about 900 MHz).

It is no accident that the nominal frequency of the PCS system—the one posing the greatest nonthermal health hazard—is higher than that of the other two!

The analysis above is based purely on theory. I should now like to summarize the experience in the field, from New York City.

(1) Coincident with the start-up of the Omnipoint system, a PCS system, electrosensitive residents of New York City found themselves experiencing horrendous sensations that threatened their health and well-being. They were force to flee the city, becoming "microwave refugees". This happened in the latter half of November, 1996.

(See two attachments from **Electrical Sensitivity News**, vol. 2: No. 1, pages 6-7, *Letter to the EMR Community* by Arthur Firstenberg; and No. 2, pages 9-11, *My Word* by Pelda Levey.)

(2) Some deaths have occurred that are alleged to have been caused by proximity to certain base transmitters. While there are no hard data that would permit these allegations to be evaluated, it is not at all unreasonable to suppose that this could be possible, if the base transmitter were a PCS one and the person who died lived quite close to it. If the health of this individual were initially compromised in some way, it would be even less surprising. (See attachment from **Electrical Sensitivity News**, vol. 2, No. 4, pages

4-5, *News from the Cellular Phone Taskforce*, by Arthur Firstenberg.)

I want to point out that electrosensitive individuals have reacted only to PCS system transmitters, not to any other kind.

Now I should like to return to the recommendation I made in my Petition for Reconsideration—that the public be protected from the nonthermal health effects of wireless telecommunication transmitters by imposing an upper limit on the permissible distance from the transmitter. It appears that such a limit is especially needed for PCS transmitters at this time, if more people are not to suffer ill effects from proximity to them. However, the data needed for establishing a limit are *not* available at this time. The type of antenna may be available in FCC records, but data on the Fourier components of the signals typically transmitted is also needed, and the FCC has not asked for this.

Also needed are data that would show the dependence of health effect on intensity, when all other factors—frequency and distance from the source—are unchanged, under a condition of exposure to an unpulsed radiation source. This is needed at different frequencies, of course.

These data have not been developed by any agency of any government of any country in the world! In other words, the basic information that is needed to establish a standard for safe exposure to the electromagnetic emissions from wireless transmitters has *never been developed!*

I wish to make another point: just from the American experience alone, there is evidence of cancer as a result of long-term exposure to microwave radiation in three different mammalian species: the laboratory rat exposed to pulsed 2.45 GHz radiation [reported in the **Bioelectromagnetics** paper]; the lymphoma-prone mice exposed to pulsed 900 MHz radiation [see the paper by Repacholi *et al.*]; and in human beings exposed to low-intensity unpulsed

(CW) radiation from traffic radar guns. This latter information was made public in a Senate sub-committee hearing chaired by Senator Joseph Lieberman of Connecticut, in August, 1992 —six months before the public scare about an alleged brain cancer hazard from the use of cellular telephones, which took place in February, 1993. I hereby incorporate the record of that Senate subcommittee hearing into this Docket, by reference.

Since I am attaching no documents from that hearing, let me explain what is relevant. For one thing, although the topic of that hearing was traffic radar guns and the reports of cancer in the law enforcement officers who had used them—which cancers they attributed to their exposure on the job to that microwave beam, because of the location on the body where the cancer appeared—William Ross Adey, M.D., who testified at that hearing, included a warning in his testimony about a cancer hazard from the use of cellular telephones. I attended that hearing, and was amazed to notice that no one paid any attention to Dr. Adey's warning about a cancer hazard associated with the use of cellular telephones.

Now I shall explain the testimony central to Senator Lieberman's hearing: the self-reports of cancer in 168 law enforcement officers at those body sites where the law enforcement officer—during years of use of the early model of traffic radar gun (which emitted a beam continuously, all day long)—had been irradiated, because of the way he positioned the traffic radar gun he had in his possession when he was not actually using it to measure the speed of a vehicle. At the hearing itself, lots of literature was being passed out. The manufacturers of traffic radar guns were strenuously denying that their product was in any way responsible for the cancers that the law enforcement officers had developed; these were just chance associations, they said, and the law enforcement officers were leaping to an unjustified conclusion when they blamed the traffic radar gun for their cancers.

As I considered this industry assertion, it occurred to me that it was susceptible to testing in a scientific manner. After the hearing was over, I performed such a test. I estimated that, nationwide, there might be 600,000 law enforcement officers who had used an original model of traffic radar gun. I assumed that 168 officers were fated to develop cancer somewhere in their bodies over the time period of interest, and tried to calculate how likely it was that cancer would have appeared just where it did—at the body site that had been irradiated by microwaves—on the assumption that there was no association between the microwave irradiation and the subsequent development of cancer, and that the apparent association was indeed a chance association, just as the industry had claimed. To do this, I estimated the volume of a tumor that might have resulted (several cubic centimeters), divided the total volume of a man into volumetric regions of this size, and used finite probability analysis to compute the probability that the cancers had occurred where they had, just by chance. I assumed that the probability of a cancer developing in a given region of the body was a function only of the volume of that region; thus I assumed that the cancer risk was independent of the type of tissue. (This is not true, of course; my model was a very simplistic one, intended only to get an order-of-magnitude answer.) My calculations yielded a probability of about one in a million that 168 law enforcement officers out of 600,000 would have developed cancer where their bodies were chronically irradiated for years by their traffic radar gun just by chance, in the absence of a causal relationship.

My model was a very crude one. But the result it gave was so highly statistically significant that it could be greatly modified, and still produce a statistically significant result. In other words, the industry assertion that the pattern of cancers observed in these law enforcement officers was a chance occurrence, was ludicrous!

Indeed, if we look at the human experience over the past 45 years, it becomes obvious that microwaves have caused a great many human deaths, many of them because of a determination to deny that they are dangerous, and to sweep the evidence under the rug, so to speak.

Yet there is evidence *just from the American experience* of cancer in three different species of mammal as a result of long-term irradiation by microwaves. And if the results of studies conducted outside the USA are added to the American experience, then there is confirmation of the cancer hazard in laboratory animals. In other words, the available evidence shows that chronic exposure to microwave radiation is carcinogenic—though it may take a long time for the cancer to manifest itself.

In summary, microwave radiation is capable of causing cancer in a variety of mammalian species, including man. That evidence exists today, both in the scientific literature and in the record of Congressional subcommittee hearings. This evidence has not been organized and summarized, but it is available for this purpose. (I myself have wanted to undertake this task since February, 1993, but have never been able to locate a sponsor willing to pay for it.)

Microwave radiation has been causing illness and death to human beings for at least 45 years—despite the many statements to the contrary by industry and the electrical engineering profession. A review of the human experience will show this, if one is ever undertaken. (I myself would like to undertake this task, but have never been able to locate a sponsor willing to pay for it. I sent an outline for a response to the evidence of cancer from traffic radar guns in law enforcement officers to Dr. Anderson at the National Cancer Institute, but he had no interest in conducting a scientific investigation of the human experience of exposure to this microwave radiation source, so no attention was paid to my plan, and—so far as I am aware—167 of the 168 law enforcement officers who developed cancer attributable to their

use of traffic radar guns died without any official investigation of their condition which might have led to official recognition of the hazard to human health posed by this microwave radiation source.)

There is an intrinsic nonthermal health hazard associated with chronic exposure to microwave radiation in the far field of a radiation source, such as a wireless telecommunication system transmitter. This risk—of cancer and of other diseases that are properly described as non-thermal health effects—is inescapable, so long as one is close enough to the source to be affected—even in the far field—by the radiation it produces. This intrinsic nonthermal health hazard is lowest for continuous (unpulsed) radiation. This represents a minimum hazard that cannot be avoided, so long as the field sources are present.

The objective of any standard that is intended to protect against the nonthermal health hazard of such radiation—given that the radiation sources may not simply be eliminated (which is the situation the FCC finds itself in)—must therefore be to prevent this minimum hazard from being increased.

Exposure to the near field of a radiation source will produce such an increase in health hazard. Therefore, the kind of standard applying to wireless transmitters that the FCC should establish to protect against nonthermal health hazards is a standard specifying a minimum distance from the radiation source. This is what I urged in my Petition for Reconsideration.

But knowing what ought to be done, and knowing how to do it, are two different things! In September, 1996, I did not provide any specific formula for establishing a minimum distance standard because I did not have the knowledge to do so.

I have enclosed my e-mail correspondence with Michael Repacholi, M.D., Dr. Ken Joyner and Dr. William Pickard to show that questions have to be resolved before this can be done

in the simple, straightforward way that a standard calls for. Notice that Dr. Pickard (in a message dated July 7, 1997) told me that the choice of formula depends, to some extent, on the type of antenna used. Notice that I asked him (on July 10, 1997) if there were a compendium of such formulas, and he replied (on July 10, 1997) saying, "If I knew of such a compendium, I'd have suggested it long since. I rather doubt that one exists, but I never made a search."

Such a compendium is essential, if the FCC is to establish a minimum distance standard around wireless telecommunication transmitters. It appears that none exists, and it does not appear that any is being developed at this time.

Of course, it may happen that there is one formula that fits virtually every antenna type. Suppose so. Then it will be possible to establish, for any given frequency, a minimum distance from the transmitter that will keep human beings "well within" the far field of the transmitter. But to apply this formula, one needs to know that frequencies are emitted by each antenna, and at what intensities. In other words, one needs the Fourier decomposition of the signal emitted! The FCC could request this information from its license applicants, but at this time, it does not. (In any case, it would probably require periodic updating, since it may change somewhat over time.)

Even if we had the right formula and the Fourier decomposition of the transmitter signal, we would also need to know the dependence of nonthermal health risk on the intensity of a continuous signal in a narrow frequency band at each of a number of different frequencies under far-field exposure conditions. (This information can be developed by systematic studies on laboratory animal, but no such studies are being done at this time.)

The purpose of this information is to provide a basis for deciding which frequencies in the Fourier decomposition are important, and which may be disregarded. The intensity of each component frequency is the parameter of interest.

For any given frequency, the inescapable risk in the far field seems to be determined by the intensity of the radiation. However, the nonthermal health risk is not *everywhere* a monotonic increasing function of the intensity, as it is when the hazard is a thermal one! The curve of nonthermal health hazard versus intensity seems to have the shape of a monotonic increasing function upon which is superimposed, in a region of quite low intensity, a bell-shaped "hump" somewhat similar to a resonance curve.

The upper limit at the high-intensity end of this curve is not a problem, because compliance with the current standard established for protection against thermal hazards automatically protects against nonthermal hazards at high intensities. It is that resonance-like "hump" at low intensities that causes the practical problems we are struggling with at this time.

The presence of this "hump" defines an intensity range—here termed the "forbidden intensity range"—over which the nonthermal hazard is increased above the inescapable minimum level for that frequency. These are intensities that are to be avoided under conditions of near-field exposure. Therefore the highest frequency in the Fourier decomposition of the signal that is present at an intensity within the "forbidden intensity range" for that frequency is the one for which the distance that puts one "well within" the near field should be determined. This distance (or some multiple of it, to provide a safety factor)—quite possibly determined by Equation (4) above—would then be the minimum safe distance from the transmitter in question.

Would data developed on laboratory animals be valid for the protection of human beings? Yes, I think so. Fundamentally, the electromagnetic field is interacting with biological molecules. One mammal is enough like another, physiologically, that the "forbidden intensity range" ought to be virtually identical for all mammals.

While we lack much of the information needed to develop such a minimum distance standard at this time, notice that from Table II we can see at once that PCS cellular telephones—the little handheld radiotelephones that people carry around with them to communicate with the base transmitters of a PCS system—are likely to be in violation of any distance standard that might be set in the manner I describe, because a great many of the frequencies associated with them would put the cellular telephone user in the their near field. Thus it is evident *right now* that these are likely to be hazardous to health, and expose their users to nonthermal health risks above the minimum that is unavoidable with such a system.

The available evidence from the field—from New York City—confirms this. It indicates the existence of a very serious hazard to health from PCS system transmitters, one which has driven a number of New York City residents out of their homes, and may have killed several who did not flee because they were not electrosensitive, and so were not aware of the havoc being wrought within their bodies.

I should like to point out that this technology is quite capable of serving as a *weapon of war!* Right now, it is being deployed in such a manner as to endanger the American public: it is being used *against* the American people!

The only rational course of action that can be taken at this time is to halt the operation of PCS systems. Any other course of action is the equivalent of an assault on the people of the United States: an act of *war!*

In my Petition for Reconsideration I requested that the FCC hold a public hearing. That was in September, 1996, before there were any people who had been made homeless by their exposure to the emissions from wireless telecommunications transmitters, and before any deaths had been attributed to the fields from these transmitters.

I now call upon the FCC to hold a public hearing within the next four months, making provision to enable electrosensitive people to testify remotely from wherever they may be located.

I further call upon the FCC to acknowledge the inadequacy of the standard it proposed on August 7, 1996, and to report to the Congress of the United States that at present there does not exist a consensus standard that is capable of protecting the public from the adverse non-thermal health effects of wireless telecommunications transmitters, nor does there exist the necessary set of scientific data upon which such a standard can be based.

I remind the FCC that a state of war exists at present between the United States and Iraq, and the deployment of a weapon of war against the American people is an act hostile to the USA and therefore friendly to America's enemies. For the FCC to continue to approve the deployment of a weapon of war against the American people is to give aid and comfort to this country's enemies: an act of *treason!*

I submit that the FCC has no duty to obey any law that Congress may pass which orders the FCC, in effect, to commit treason. I submit that the FCC *does* have a duty to cease and desist implementing the Telecommunications Act of 1996 in such a way as to endanger the public health—which the FCC is doing at this time.

I urge the FCC to seek legal advice from the Supreme Court of the United States, if it feels that it must receive legal permission before deviating from those activities mandated by the Telecommunications Act of 1996.

Respectfully submitted,

Marjorie Lundquist

Marjorie Lundquist, Ph.D., C.I.H.
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Attachments: Exhibit A: Abstract of Repacholi paper **[Radiation Research 147**, 631-640]
Abstract of Chou paper {**Bioelectromagnetics 13**, 469-496]
Table 2 from Chou paper

Exhibit B: **Electrical Sensitivity News 2**, No. 1; pages 6-7.
Electrical Sensitivity News 2, No. 2; pages 9-11.
Electrical Sensitivity News 2, No. 4; pages 4-5.

Exhibit C: electronic mail correspondence between me and three other individuals between June 12, 1997, and July 10, 1997: Michael H. Repacholi, M.D. (World Health Organization); Ken Joyner (a Ph.D. physicist formerly with Telstra Research Labs in Melbourne, Australia, now working for Motorola); and William F. Pickard, Ph.D. (Electrical Engineering Department, Washington University, St. Louis, MO)

EXHIBIT A - Page 1

RADIATION RESEARCH 147, 631–640 (1997)
0033-7587/97 $5.00

Lymphomas in Eμ-*Pim1* Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields

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Repacholi, M. H., Basten, A., Gebski, V., Noonan, D., Finnie, J. and Harris, A. W. Lymphomas in Eμ-*Pim1* Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields. *Radiat. Res.* 147, 631–640 (1997).

Whether radiofrequency (RF) fields are carcinogenic is controversial; epidemiological data have been inconclusive and animal tests limited. The aim of the present study was to determine whether long-term exposure to pulse-modulated RF fields similar to those used in digital mobile telecommunications would increase the incidence of lymphoma in Eμ-*Pim1* transgenic mice, which are moderately predisposed to develop lymphoma spontaneously. One hundred female Eμ-*Pim1* mice were sham-exposed and 101 were exposed for two 30-min periods per day for up to 18 months to plane-wave fields of 900 MHz with a pulse repetition frequency of 217 Hz and a pulse width of 0.6 ms. Incident power densities were 2.6–13 W/m^2 and specific absorption rates were 0.008–4.2 W/kg, averaging 0.13–1.4 W/kg. Lymphoma risk was found to be significantly higher in the exposed mice than in the controls (OR = 2.4, P = 0.006, 95% CI = 1.3–4.5). Follicular lymphomas were the major contributor to the increased tumor incidence. Thus long-term intermittent exposure to RF fields can enhance the probability that mice carrying a lymphomagenic oncogene will develop lymphomas. We suggest that such genetically cancer-prone mice provide an experimental system for more detailed assessment of dose–response relationships for risk of cancer after RF-field exposure.

INTRODUCTION

Concern has been expressed for a number of years that exposure to radiofrequency (RF) fields emanating from telecommunications devices, heating equipment and radar and television transmitters may increase the incidence of cancer in humans. Epidemiological studies have not indicated an increased cancer risk, but the methodology and exposure assessments are generally considered to have been suboptimal (*1–3*).

The mechanisms presently known by which normal cells are transformed into neoplastic cells involve alterations to the structure of somatic cell DNA such as point mutations, translocations, deletions, amplifications and retroviral provirus insertions (*4, 5*). Experiments reviewed for the World Health Organization (*2*) and for the National Radiological Protection Board of the UK (*1*) did not demonstrate convincingly any direct damage to DNA after acute or chronic exposure of biological systems to RF fields. In particular, when temperatures were maintained within normal physiological limits, no evidence for induction of DNA breaks or chromosome aberrations was found. On the other hand, two recent studies have suggested that RF fields can affect DNA. In the first, Sarkar *et al.* (*6*) found evidence of an alteration in the length of a DNA microsatellite sequence in brain and testis cells of mice exposed to 2.45 GHz fields at a specific power absorption rate (SAR) of 1.2 W/kg for 2 h/day for up to 200 days. In the second, Lai and Singh (*7*) reported the occurrence of single-strand breaks in rat brain DNA shortly after the animals had been exposed for 2 h to pulsed or continuous-wave 2.45 GHz fields with SARs of 0.6 or 1.2 W/kg. Until these results and their interpretation are confirmed, doubt will remain as to whether RF fields can induce any of the types of genetic change in cells that lead to malignancy.

A number of studies in experimental animals have sought to determine directly whether RF fields can affect the development of cancer. Szmigielski *et al.* (*8*) and Szudzinski *et al.* (*9*) reported that chronic exposure of mice to RF fields (2.45 GHz, SAR 2–8 W/kg, 2 h/day, 5–6 days per week for up to 12 months) accelerated the development of metastatic colonies from transplanted sarcoma cells and increased the incidence of primary mammary tumors in predisposed animals and of skin tumors induced with 3,4-benzopyrene. Further work by this group (*10*) found that similar exposures increased the number of hepatomas, sarcomas and skin tumors in mice treated with chemical carcinogens. On the other hand, Wu *et al.* (*11*) were unable to demonstrate significant enhancement of colon carcinogenesis by

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Long-Term, Low-Level Microwave Irradiation of Rats

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Our goal was to investigate effects of long-term exposure to pulsed microwave radiation. The major emphasis was to expose a large sample of experimental animals throughout their lifetimes and to monitor them for effects on general health and longevity.

An exposure facility was developed that enabled 200 rats to be maintained under specific-pathogen-free (SPF) conditions while housed individually in circularly-polarized waveguides. The exposure facility consisted of two rooms, each containing 50 active waveguides and 50 waveguides for sham (control) exposures. The experimental rats were exposed to 2,450-MHz pulsed microwaves at 800 pps with a 10-μs pulse width. The pulsed microwaves were square-wave modulated at 8-Hz. Whole body calorimetry, thermographic analysis, and power-meter analysis indicated that microwaves delivered at 0.144 W to each exposure waveguide resulted in an average specific absorption rate (SAR) that ranged from 0.4 W/kg for a 200-g rat to 0.15 W/kg for an 800-g rat.

Two hundred male, Sprague-Dawley rats were assigned in equal numbers to radiation-exposure and sham-exposure conditions. Exposure began at 8 weeks of age and continued daily, 21.5 h/day, for 25 months. Animals were bled at regular intervals and blood samples were analyzed for serum chemistries, hematological values, protein electrophoretic patterns, thyroxine, and plasma corticosterone levels. In addition to daily measures of body mass, food and water consumption by all animals, O_2 consumption and CO_2 production were periodically measured in a sub-sample (N=18) of each group. Activity was assessed in an open-field apparatus at regular intervals throughout the study. After 13 months, 10 rats from each group were euthanatized to test for immunological competence and to permit whole-body analysis, as well as gross and histopathological examinations. At the end of 25 months, the survivors (11 sham-exposed and 12 radiation-exposed rats) were euthanatized for similar analyses. The other 157 animals were examined histopathologically when they died spontaneously or were terminated *in extremis*.

Statistical analyses by parametric and non-parametric tests of 155 parameters were negative overall for effects on general health, longevity, cause of death, or lesions associated with aging and benign neoplasia. Positive findings of effects on corticosterone level and immune system at 13 months exposure were not confirmed in a follow-up study of 20 exposed and 20 control rats. Differences in O_2 consumption and CO_2 production were found in young rats. A statistically significant increase of primary malignancies in exposed rats vs. incidence in controls is a provocative finding, but the biological significance of this effect in the absence of truncated longevity is conjectural. The positive findings need independent experimental evaluation. Overall, the results indicate that there were no definitive biological effects in rats chronically exposed to RF radiation at 2,450 MHz.

Key words: SAR, longevity, health, tumor incidence

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TABLE 2. Neoplastic Lesions Per Organ System

Organ	Lesions	Exposed			Sham-exposed		
		B	P	M	B	P	M
Adrenal	Adenoma	0	0	0	1	0	0
	Carcinoma	0	0	0	0	1	0
	Cortical adenoma	10	0	0	10	0	0
	Cortical carcinoma	0	3	0	0	0	0
	Myelomonocytic leukemia	0	0	0	0	0	1
	Malignant lymphoma	0	0	1	0	0	0
	Pheochromocytoma	7	0	0	1	0	0
Blood vessel	Hemangiosarcoma	0	1	0	0	0	0
Bone marrow	Leukemia	0	0	0	0	0	1
	Myelomonocytic leukemia	0	0	1	0	0	1
	Malignant lymphoma	0	1	0	0	0	0
Brain	Myelomonocytic leukemia	0	0	0	0	0	1
	Malignant lymphoma	0	0	2	0	0	0
Cervical	Myelomonocytic leukemia	0	0	0	0	0	1
Lymph node	Lymphocytic lymphoma	0	0	0	0	1	0
	Malignant lymphoma	0	0	0	0	0	1
Colon	Malignant lymphoma	0	0	1	0	0	0
Duodenum	Myelomonocytic leukemia	0	0	1	0	0	0
	Malignant lymphoma	0	0	1	0	0	0
	Squamous cell carcinoma	0	0	1	0	0	0
Edipidymis	Squamous cell carcinoma	0	0	1	0	0	0
Eye	Leukemia	0	0	0	0	0	1
Heart	Myelomonocytic leukemia	0	0	1	0	0	1
	Malignant lymphoma	0	0	1	0	0	0
	Neurinoma	1	0	0	2	0	0
Kidney	Leukemia	0	0	0	0	0	1
	Myelomonocytic leukemia	0	0	1	0	0	1
	Malignant lymphoma	0	0	1	0	0	0
	Nephroblastoma	1	0	0	1	0	0
Liver	Adenoma	2	0	0	0	0	0
	Carcinoma	0	0	0	0	1	0
	Hepatocellular adenoma	1	0	0	0	0	0
	Leukemia	0	0	0	0	0	1
	Myelomonocytic leukemia	0	0	2	0	0	1
	Malignant lymphoma	0	0	1	0	0	1
	Squamous cell carcinoma	0	0	1	0	0	0
Lung	Leukemia	0	0	0	0	0	1
	Myelomonocytic leukemia	0	0	1	0	0	0
	Malignant lymphoma	0	0	1	0	0	0
Lymph node	Myelomonocytic leukemia	0	1	2	0	1	0
	Malignant lymphoma	0	0	1	0	0	0
	Transitional cell carcinoma	0	0	1	0	0	0
Mesentery	Transitional cell carcinoma	0	0	1	0	0	0
Nasal cavity	Leukemia	0	0	0	0	0	1
Pancreas	Adenoma	0	0	0	1	0	0
	Islet-cell adenoma	1	0	0	1	0	0
	Squamous cell carcinoma	0	0	1	0	0	0
Parathyroid	Malignant lymphoma	0	0	1	0	0	0
Parotid SG	Myelomonocytic leukemia	0	0	1	0	0	0
Peritoneum	Liposarcoma	0	1	0	0	0	0
Pituitary	Adenoma	17	0	0	21	0	0
	Carcinoma	0	2	0	0	0	0
Preputial gland	Malignant lymphoma	0	0	1	0	0	0
Skeletal muscle	Myelomonocytic leukemia	0	0	1	0	0	0
Skin	Auditory sebaceous sq carcinoma	0	1	0	0	0	0
	Basal cell carcinoma	0	1	0	0	0	0
	Basal cell tumor	1	0	0	0	0	0
	Keratoacanthoma	1	0	0	1	0	0
	Malignant lymphoma	0	0	1	0	0	0
	Pilomatricoma	1	0	0	0	0	0
	Sebaceous adenoma	2	0	0	0	0	0
Spleen	Myelomonocytic leukemia	0	0	1	0	0	1
	Malignant lymphoma	0	0	1	0	0	0
Stomach	Malignant lymphoma	0	0	1	0	0	0
	Squamous cell carcinoma	0	1	0	0	0	0
	Squamous cell papilloma	3	0	0	4	0	0
SubQ tissue	Fibroma	1	0	0	0	0	0
	Fibrosarcoma	0	1	0	0	0	0
	Lipoma	1	0	0	0	0	0
	Neurinoma	0	0	0	1	0	0
Testes	Benign interstitial cell tumor	1	0	0	0	0	0
	Squamous cell carcinoma	0	0	1	0	0	0
Thymus	Myelomonocytic leukemia	0	1	0	0	0	0
	Lymphocytic lymphoma	0	1	0	0	0	0
	Malignant lymphoma	0	0	0	0	1	0
Thyroid	Adenoma C-cell	10	0	0	9	0	0
	Carcinoma C-cell	0	2	0	0	0	0
	Leukemia	0	0	0	0	0	1
	Malignant lymphoma	0	0	1	0	0	0
Ureter	Malignant lymphoma	0	0	1	0	0	0
Urin/bladder	Transitional cell carcinoma	0	1	0	0	0	0
	Transitional cell papilloma	1	0	0	0	0	0
Zymbal's gland	Leukemia	0	0	0	0	0	1
Total		62	18	36	53	5	18

This table lists neoplastic lesions found per organ system. These lesions may be benign (B), a primary malignancy (P), or a metastatic malignancy (M) arising from a primary malignancy in another organ system (i.e., a malignant neoplasm may occur as a metastatic malignancy in many organs of a single animal, but as a primary malignancy in only one organ system of an animal).

Continued

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those that would produce significant and measurable heating, the evidence for production of harmful biological effects is less clear. A number of reports have appeared in the Russian and East European literature claiming a wide range of low-level biological effects. The low-level effects on animals and humans reported in the Soviet and East European literature have included behavioral modifications, effects on the blood-forming and immunological system, reproductive effects, changes in hormone levels, headaches, irritability, fatigue, and cardiovascular effects. However, further research is needed to confirm the existence of these effects and to determine whether they might constitute a health hazard, particularly with regard to long-term exposure.

In recent years some Western scientists have also reported biological effects after exposure of animals and animal tissue to relatively low levels of RF radiation. These effects, often referred to as "non-thermal" effects, have included changes in the immune system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, and a "calcium efflux" effect in brain tissue (discussed below). Experimental results have also suggested that microwaves might be involved in cancer "promotion" under certain conditions. However, contradictory experimental results have also been reported in many of these cases, and further experiments are needed to determine the generality of these effects and whether they constitute a threat to human health. It is possible that "non-thermal" mechanisms exist that could cause harmful biological effects in animals and humans exposed to RF radiation. However, whether this is the case remains to be proven.

One of the "non-thermal" biological effects that appears to be reproducible is the "calcium efflux" effect. This effect can be described as the observation that the release of calcium ions from animal brain tissue is enhanced after exposure to certain low intensities of RF radiation under discrete conditions of frequency and signal modulation. This effect has been observed at RF levels well below those necessary to produce heating of tissue. The extent to which this effect might indicate a hazard is not presently know, and further research is needed to determine the relevance, if any, of this phenomenon to human health.

Another RF biological effect that has received attention is the so-called microwave "hearing" effect. Under certain specific conditions of frequency, signal modulation, and intensity, it has been shown that animals and humans can perceive an RF signal as a buzzing or clicking sound. Although a number of theories have been advanced to explain this effect, the most widely-accepted hypothesis is that the microwave signal produces thermoelastic pressure within the head that is perceived as sound by the auditory apparatus within the ear. It is important to emphasize that the conditions under which this effect occurs **would not** normally be encountered by members of the general public.

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Letter to the EMR Community

Arthur Firstenberg - USA

In what amounts to a massive biological experiment, Omnipoint Communications and Primeco Personal Communications, activated the first Personal Communications Services (P.C.S.) systems in 16 metropolitan areas throughout the United States. This is a new type of cellular service. I can unfortunately state that its effects are already deadly.

In drafting this letter I struggled with whether to include a list of my own symptoms. It seems hard to convey the impact of this technology in any other way, so with some hesitation I will describe what I have experienced: terrible burning pain in the middle of my chest, burning pain in my testicles, tremors, extreme weakness, dry puffy lips, swollen throat, pain in my eyeballs and the feeling that they are protruding from my head, pain in my ears, dizziness, headache, pain and stiffness in every joint. Every inch of my skin was sensitive to the touch. I could hardly eat and I was completely unable to sleep. To save my life I have left New York City. The relief is unbelievable.

I hear similar reports from other electrically sensitive people throughout the New York metropolitan area. Their situations are desperate. Some who are not electrically sensitive also report the same symptoms. This is immensely powerful radiation and like nothing any of us has ever experienced before.

The following cities are blanketed by these microwaves as of last week: Norfolk and Richmond, Virginia; Fort Lauderdale, Jacksonville, Miami, Orlando and Tampa, Florida; Chicago; Milwaukee;

New Orleans; Dallas, Fort Worth, Houston and San Antonio, Texas; and Honolulu. I understand Omnipoint plans to have the entirety of New York State covered by next summer, as well as Massachusetts, Connecticut, New Jersey, much of Pennsylvania, and Delaware. Between Omnipoint, Primeco, Sprint, AT&T and other competitors, there may well be no square inch of the United States uncovered by this technology in a matter of months. I believe the situation in the rest of the world is similar. Our planet is in grave danger.

I have put together a booklet (85 pages) containing information the telecommunications industry and regulatory bodies have said does not exist, i.e. consistent, repeatedly verified proof of health hazards of low-level microwave radiation compiled by researchers over the last 70 years. Ecological hazards are also included. For a copy of Microwaving Our Planet: The Environmental Impact of the Wireless Revolution, please send $25 to Arthur Firstenberg, PO Box 100404, Brooklyn NY 11210. The money will be used to fund a publicity campaign and legal action.

UPDATE: I have never experienced such torturous pain in my life as during my last week in New York City, nor have I ever experienced such relief as that day in the woods in Suffolk County. During the past few weeks I have been needing shelter. About half the time I have not had it, and now it is snowing and below freezing at night. I urgently need environmentally safe housing of some sort, which at minimum means hardwood floor, no smoking or fragrances, and no TV, computer, microwave oven or cordless telephone in use in the house. Also no nearby radar, transmitting antenna, or major power line. A space on someone's floor would be a blessing, but the environmental needs are not flexible. To continue my work with the Cellular Phone Taskforce I will need access to a telephone for at least the next several months. The work that needs to be done cannot wait.

First, the publicity campaign. This is either going to be the most ignored environmental story in history, or the biggest one ever, and it is probably up to us which. There are reporters following this story who are waiting to see if it has legs or not. **We need numbers, and we need them now. If you or anybody you know has been injured by a cellular tower and is willing to be interviewed by the press, please contact me by mail or phone:** (718) 434-4499, my Brooklyn phone number now has an answering machine on it.

We are also preparing newspaper advertisements, surveys to send to physicians, and leaflets for the streets, in an effort to determine how widespread the suffering is. This all costs money. The Department of Health should be doing this. It is instead being done by a team of people who are either ill or have left their homes.

We have just retained a lawyer to represent us in the first stage of legal action, i.e. a temporary restraining order to shut down this system. For this we also need numbers. We must demonstrate that significant numbers of people are being injured (particularly in New York City). Again, please contact me if you or people you know are ill. We also need contributions toward our legal expenses.

Neither the publicity nor the lawsuit can wait. It is now or never. This PCS technology will be where you are before you can blink, if it isn't there already, and this is an environmental threat unlike any other. Business will not be as usual. According to clinical studies, at least 15% of the population, or 40,000,000 Americans, will suffer radiation sickness, and since there will be no escape from the radiation, that sickness will be permanent and progressive. Injury to the rest of us will show up in other ways. Life expectancy will plummet. Birth defects and sterility will suddenly rise. 1998 will be a silent spring, and no one will know why.

For that is the horror of this new technology, that by the summer of 1997 there will be no place to go to escape from it. For those of us who have already been injured, there is almost no place to go now.

(**Editor's note**: According to a New York Times article on November 18 ("Two New Standards for Wireless in Duel"), New York City's PCS cellular phone system is a GSM type. The other cities mentioned have a Primeco CDMA cellular system. GSM, CDMA, and AT&T's TDMA are variations of PCS digital (pulsed microwave) phone systems being installed throughout the U.S.A.

If you or someone you know had/has an adverse reaction to cellular system activation, please also let me know. If you are ES and are able to use a phone, let me know if you are willing to be contacted by the media. Please remember to maintain the privacy of those you network with, particularly if you are in contact with the media.

As I see it, the ES are in serious need of assistance from legal, media, and government contacts due to the impending land-based cellular phone antennas and satellite wireless communications technology. Our problem is one not only of a disability nature, but a major civil rights issue due to

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News from the Cellular Phone Taskforce

Arthur Firstenberg - USA

Publicity. Pelda Levey's Op Ed piece entitled "FCC ignoring health effects of cell phone antenna towers" appeared in the Hartford Courant on February 12. Our Town newspaper in New York is doing a story on this, appearing February 19.

Meetings. The Cellular Phone Taskforce meets on the first and third Sundays of each month. Contact Jimmy Haller at (201) 701-1529 for time and place of meetings.

Other activity. Our New York Press classified ad has been running since Christmas and has produced over 100 phone calls from men and women in all five boroughs, Westchester and New Jersey. All have similar stories of becoming ill suddenly in mid-November and being unable to shake the illness. All report that their friends, relatives, and colleagues are also sick and that this "unusual flu season" is the talk of the town. Many people have headaches for the first time in their lives. Dehydration, sometimes severe, has sent some to the emergency room. Chest pain has made some fear they were having a heart attack. A few also have itchy rashes all over their bodies. The elderly are particularly affected. I have gotten several calls from older people whose breathing has been affected severely and who can't leave their homes.

A disability discrimination complaint against the Federal Communications Commission was filed by the Cellular Phone Taskforce on February 3. The complaint states that the Radiofrequency Safety Guidelines adopted last August 6 by the FCC discriminate against the electrically sensitive.

News from the industry. Omnipoint's coverage map indicates there is already roaming service (i.e. other compatible PCS systems) available in San Diego, Honolulu, Knoxville, and most cities in North and South Carolina. The latest issue of Iridium Today boasts that Motorola's first three low earth orbit satellites are up there. The City of New York issued a Request For Proposals on the lamppost project November 23. Three thousand lampposts, traffic lights, and highway signs will carry new cellular antennas this summer. Metricom is already using the lampposts in San Francisco, Seattle, Corvallis, Eugene, and the District of Columbia to provide wireless Internet service.

Microwave hearing, I discovered, can be relieved by a close fitting metallic hat. I improvised one out of aluminum foil. It is an easy way to verify the electronic source of these sounds, and has convinced me the Taos Hum is microwave effect.

My own travels, I hope, have ended. I am looking for housing in the area of Norwich, New York. I have been dismayed to find cellular towers virtually everywhere I went, even in forested areas where there are no people, throughout New York, Pennsylvania, West Virginia and Vermont. I carried a cellular phone with me, donated by my nephew Mark, to indicate signal strength. I visited the National Radio Astronomy Observatory in West Virginia, as it is supposed to be in a radio quiet zone, only to discover that the area without cellular reception is actually a very small unpopulated area, and that the electronic noise in my head was still there.

Needs. We STILL need a lawyer to represent the large numbers of people who are being injured. Please leave a message for me at (718) 434-4499 if you are an interested lawyer or you know one.

I would like to thank the many people who have sent me contributions, which have helped with the costs of phone calls, postage, copying, advertising, legal consultations, and keeping Microwaving Our Planet in print.

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My Word

Pelda B. Levey - USA

(**Editor's note:** This article is reprinted from the